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"Theoretical and Experimental Studies
of the Underlying Processes and Techniques
of Low Pressure Measurement"

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The activities in the program on low pressure measurements have covered the following general activities during the past six months and will be briefly described under these headings:

1. Measurement of the Pumping Speed of Ion-Getter Pumps at Low Pressures
2. Processing of Ultrahigh Vacuum Systems
3. Production of CO in the Presence of O_2 in Ultrahigh Vacuum Systems
4. High Resolution Electron Spectrometer
5. Measurements of the Angular Distributions of Secondary Electrons
6. Adsorption-Desorption of Gases.

1. Measurement of the Pumping Speed of Ion-Getter Pumps at Low Pressures

A description of the program and preliminary results were presented in the last semiannual report. During the last six months, a pressure controller has been added to the experiment. More accurate and reproducible data have been realized due to this modification. However, the qualitative behavior and conclusion presented previously are not essentially modified.

Measurements on ion-getter pumps of the slotted cathode geometry have been initiated, and measurements on triode pumps are planned.

2. Processing of Ultrahigh Vacuum Systems

The typical pump-down, bakeout, outgassing cycle used to process ultrahigh vacuum systems suffers from several disadvantages. Among these are that the trap is left contaminated and the system is exposed to the vapors of the pumping system during bakeout. Lange and Singleton[1] recently reported improved performance of such systems by incorporating a valve between the chamber to be evacuated and the trap, and by following a particular routine of baking. This technique has been used in this laboratory with considerable success. Typically, the ultimate pressure of a system can be reduced greater than an order of magnitude by the procedure. A system has been assembled to study processing quantitatively, in an effort to determine the sources of gas and the type of gases given off by these sources.

3. Production of CO in the Presence of O_2 in Ultrahigh Vacuum Systems

In a recent publication, Schuemann, de Segovia, and Alpert[2] reported a high rate of production of CO in an ultrahigh vacuum system under the condition of a relatively high rate of flow of O_2 through the system and in which a hot cathode ionization gauge was operating. The exact reasons for this high rate of production were not established in that work. Recent measurements indicate that the rate of production of CO is much reduced in a system processed using the technique discussed in the previous section. A system has been assembled to study this effect and to attempt to ascertain the mechanism involved.

4. High Resolution Electron Spectrometer

Preliminary data has been obtained with the electron spectrometer described in the previous status report. A number of interesting features have been observed for a 110 single crystal tungsten target. Among these are:

a) a clear separation of elastically and inelastically scattered electrons to primary energies below 10 eV;

b) structure in the inelastic region of the secondary distribution;

c) an elastic peak of almost constant half width from 2 eV to 50 eV primary energies.

The results are preliminary and more work is required to verify the exact situation.

A number of modifications have been made to improve the sensitivity of the instrument.

5. Measurements of the Angular Distributions of Secondary Electrons

The design of this instrument is essentially complete and the fabrication is almost finished. The double-trap, mercury-diffusion-pumped vacuum chamber has been completed and initial tests performed which indicate that the mercury contamination will be at an extremely low level.

6. Adsorption-Desorption of Gases

The apparatus for this experiment was essentially completed in the last six months. Several modifications have been made. In particular, the ion source-lens system has been redesigned and is now suitable for preliminary measurements. Additional work on the source-lens system is being carried on to increase the sensitivity of this experiment and the experiment described under 5 above.

References

[1]Lange and Singleton, Journ. Vac. Sci. & Tech. 2, 93 (March/April 1965).

[2]Schuemann, W. C., de Segovia, J. L., & Alpert, D. 1963 Transactions of the Tenth National Vacuum Symposium of the American Vacuum Society, (Boston, Mass., October 16-18), p. 223.